

**Tribhuvan University  
Institute of Science and Technology**

**Course Title: Introduction to Cognitive Science**

**Course no:** CSC-255

**Credit hours :** 3

**Full Marks:** 60+20+20

**Pass Marks:** 24+8+8

**Nature of course :** Theory (3 Hrs.) + Lab (3 Hrs.)

**Course Synopsis :** An introduction to cognitive science and its relation with other sciences. It covers briefly the area of Artificial Intelligence, Computational models and connectionist approach.

**Goal:**

The student will gain an introductory understanding of what it means to say that intelligence is computational. The student will:

- Acquire a good understanding of what an algorithm is and learn how to implement algorithms in the programming language LISP/PROLOG.
- Develop an introductory understanding of formal models for computation, the limits of computation, the Chomsky hierarchy, and the Turing-Church hypothesis

The student will study some of the modern attempts to demonstrate a computational model for intelligence through an introduction to the discipline of artificial intelligence, including introductions to knowledge representation, search, and artificial neural networks.

Finally, the student will explore some of the positions taken in the ongoing discussion of this issue. In Philosophy and Linguistics, we will begin with Descartes, and look (and discuss) Turing, Gelernter, Newell and Simon, Penrose, Searle, and others, finishing with a partial response to Descartes given to us by Chomsky and others.

**Course Contents:**

**Unit 1. Introduction to the Problem**

**6 Hrs.**

Cognitive Science and other Science:

*Psychology, Philosophy, Sociology, Computer Science(AI), Biology(Neuroscience), Linguistics and mathematics*

Descartes Mind Body Problem

Marr's three level view of information processing:

*Computational, Algorithmic & Implementational*

Turing's response to Descartes

Application related system in the Cognitive Science:

*NLP, Neural N/W, AI, .....*

**Unit 2. Brief Introduction to Artificial Intelligence**

**13 Hrs.**

History and background of Artificial Intelligence:

*Introduction and history*

*Think rationally, act rationally and Think humanly, act humanly*

Knowledge representation:

Rule based: *If then*

Object based: *Frames, Semantic n/w, O-A-V*

*Simple examples of predicate logic, overview of FOPL*

Human information processing and problem solving:

*If then rule*

*Example: Water Leakage Problem*

Search:

Informed (Heuristic) Search: *Hill-climbing search, A\* search*

Uninformed (Blind) Search: *Depth-first search, Breadth-first search*

Expert system:

*Block diagram*

Introduction of Neural Networks:

*Synapse, neuron*

*Mathematical model*

### **Unit 3. Computation**

**11 Hrs.**

Introduction: *Computation and Cognition*

Basic Model for Computation,

The Turing Machine,

Computational and Language: the Chomsky hierarchy: *Type 0, Type 1, Type 2, Type3*

The Physical Symbols Systems Hypothesis,

Illustration of practical examples.

### **Unit 4. Approaches**

**15 Hrs.**

The connectionist approach, Different models and tool:

*Hebbian Learning, Perceptron, Back propagation*

Gelernter, Penrose, Pinker, Searle; Response to Descartes:

Natural Language Processing:

*Natural Language Understanding and Generating*

*Lexicon, Morphology*

*Syntactic Analysis: Parse tree*

Parameters in the Natural Language Processing:

*Auditory Inputs, Segmentation, Syntax, Semantics, Pragmatics*

**Text / Reference books:**

1. Thinking about consciousness / David Papineau, Oxford: Clarendon Press New York: Oxford University Press, 2002.
2. Copeland, Jack: *Artificial Intelligence: A Philosophical Introduction*, Blackwell Publishers.
3. Cognition in a digital world / edited by Herre van Oostendorp, Mahwah, N.J.: L. Erlbaum Associates, 2003
4. The evolution and function of cognition / Felix Goodson, Mahwah, N.J.: Lawrence Erlbaum Associates, Publishers, 2003.